SPRING-LOADED LOAD RESTRAINT WINCH SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a Continuation-in-Part of Application Serial No. 10/225,357 filed 08/22/2002, which is a Continuation-in-Part of Application Serial No. 09/532,080, filed 03/21/2000, and of 09/661,081, filed 09/13/2000, the specifications of which are embodied herein by way of reference.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention is directed to a load restraint system, and in particular to a safety adaptation to a load restraint system, for retrofitting truck load winches, used for securing loads to flatbeds, trucks and the like, into a spring loaded safety winch, and to OEM spring-loaded winches.

2. DESCRIPTION OF THE PRIOR ART

The attachment of loads upon the beds of vehicles, for safe transportation, usually relies upon hold-down members, such as straps, chains and the like that are passed over the load and secured to the sides of the vehicle, and there tensioned.

Tensioning of the hold-down members is usually effected by use of an in-situ, hand-operated winch to which one end of the hold-down member is attached.

The winch has a drum, about which an end of the hold-down member is wound. The drum has a capstan which is rotated by means of a lever or Tommy-bar that is inserted into a selected hole in the drum capstan, and the bar is then cranked angularly, to wind the hold-down member onto the drum, and to tension it.

The winch drum has a toothed ratchet wheel at one end, which may be located adjacent

the capstan, or located at the opposite end of the winch, against which ratchet wheel a ratchet pawl engages, to prevent reversed, overhauling rotation of the drum, which would result in the loss of the tension that is applied to the hold-down member.

The use of nylon or other straps of suitable plastic may provide a degree of elasticity to the load restraint system. However, despite such elasticity, there is a distressingly frequent loss of tension in the hold-down member, due to settling of the load. This loss in tension frequently results in a major shifting of the load, often with disastrous, and frequently fatal consequences for the trucker and often for other road users.

In cases where cables or chains are used as the hold-down member, the maintenance of tension is an even greater problem, due to a substantial absence of elasticity and resilience in the hold-down member. Any settling of the load can lead to instantaneous loss of hold-down tension, which can then lead rapidly to shifting of the load. This particularly applies to loads such as logs.

This problem of inadequate security of load attachment is currently leading towards legislation proposing that, in the case of road trucks, for every three hours of travel or 150 miles covered, the vehicle shall be halted and the tension of the load securing hold-down members be checked.As there are usually a significant number of load members and their associated winches along the length of a modern, extended transport truck and/or trailer, such further checking involves theexpenditure of considerable further time and effort on the part of the driver.

Added to this is the roadside hazard, affecting both passing traffic, in the event that there is no proper pull-off, and more particularly the truck driver, who is particularly vulnerable beside the truck, when preoccupied in pulling down with full force against

each of many winches, to re-tension the respective hold-down members.

A particularly adverse factor is the the gross physical strain imposed upon the driver, particularly to the shoulders and back, the latter being especially vulnerable to injury, due to the repetitious pulling down, winch after winch, and time after time.

Instances of severe frontal injury and even death have occurred, usually due to kick-back or dislocation and forcible discharge of the loading bar from the winch.

One earlier attempt to deal with the problem is presented in U.S.Patent No. Re.30,307 (re-issued) June 17 1980 (Arbogast). This prior art arrangement had a hollow drum rotatably mounted in a frame, with an external eyelet on the drum for attachment of the loading cable thereto. The drum contained an unsupported helical spring. The drum had two ratchet wheel/pawl combinations, located at opposite ends of the winch frame. Each ratchet wheel also incorporated a capstan.

A first ratchet wheel was connected to the drum, to prevent overhauling of the drum by the tensioned, load-restraining cable or chain; the second ratchet wheel was connected to one end of the helical spring. The other end of the helical spring was attached to the interior of the drum. In use, a tommy bar was inserted in the capstan of the first ratchet wheel, and the drum was rotated, to wind-on and tension the cable or chain. The tommy bar was then withdrawn, relocated in the capstan of the second ratchet wheel, and rotated in the same direction, to tension the spring, the spring load being maintained by the second ratchet wheel pawl. This earlier arrangement suffered from the disadvantages that the spring was of such low tension that it could wrap about a central shaft, otherwise being substantially unsupported when in a partially tensioned condition; also, in operation it was necessary to relocate the load tommy bar from the first capstan to the second, both

for applying the initial loading , and at any subsequent re-checking of cable tension. Also, both capstans were loaded in the same rotational direction

For unloading of the cable it was necessary to first insert the tommy bar in the second capstan, to further tension the spring and enable disengagement of the associated ratchet pawl; then release the ratchet pawl and ease back on the tommy bar so as to dissipate the tension in the spring; the tommy bar being then relocated in the first capstan, the pawl released, and the cable or chain detensioned with the tommy bar, under control, and then released.

The limited spring support provision of Arbogast's central shaft provided virtually no inherent load limitation, so that in view of the spring's evident low stiffness, the spring could be readily over-tensioned and suffer permanent deformation. Also, the spring required several leverings with the tommy bar in order to apply sufficient tension to it.

This and earlier attempts appear to have been unsuccessful, as the problem of loss in tension in load hold-down members has remained, leading to the above-mentioned proposed legislative solution.

SUMMARY OF THE INVENTION

The present invention has a number of embodiments, which are applicable to OEM equipment and also provide retro-fit improvements to prior-existing load restraint winch systems, as used for securing an elongated load hold-down member such as a load strap in secured, tensioned relation.

The winch systems presently in widespread use generally comprise a winch having a rotatable drum; manually operated torque-applying capstan means for rotating the drum to wind-on and apply load-securing tension to the hold-down member; and ratchet means to prevent over-hauling of the drum by the tensioned hold-down member. The winch

drums frequently comprise a slotted cylinder, through which slots a load strap can be threaded. Other winch drums may comprise a squirrel cage comprised of three or more parallel bars, through and about which the load strap or other member is threaded and wound.

The retro-fit improvement embodiment for existing winches consists of spring-loaded tensioning means, for external attachment to the prior winch in torque-transfer relation therewith , the spring-loaded tensioning means being attached in releasably secured relation, to the existing winch capstan means, leaving undisturbed the original winch ratchet.

A ratchet wheel and ratchet pawl portion of the attached spring loaded tensioning means provides selective coupling of the tensioning spring to the winch drum in torque-transfer relation therewith, to drive the drum in tension-maintaining relation with the hold-down member.

The attachable embodiment has a mounting cylinder that axially telescopes with the capstan portion of an existing winch, the mounting cylinder being pinned in place by way of a shear pin that engages the tommy bar holes of the capstan, thus locking the cylinder and original capstan together in torque transfer relation.

A retainer cylinder, slid over the mounting cylinder may be used to retain the shear pin in place.

A spring assembly is rotatably mounted substantially coaxial with the mounting cylinder, and may serve as an alternative to the retainer cylinder to trap the shear pin against withdrawal.

The spring assembly has a barrel portion that slides in rotatable relation over the

mounting cylinder, or the retainer , whichever is radially outermost. . The barrel portion has the helical torsion spring loosely mounted thereon.

A lobed end plate secured to the outer end of the barrel carries a bracket by which the spring outer end is secured to the end plate. The spring inner end is removably attached to the adjacent outer end face of the winch frame, by way of an angled bracket welded to the face of the frame, to form a retention aperture.

The barrel preferably has an outwardly extending loading bracket with an offset capstan hole, by means of which the barrel can be rotated, using a standard tommy bar, pulling in an upward direction

The bracket is sized and located for upward rotation by way of a tommy bar, for approximately **170** ??? degrees rotation of the barrel and of the spring outer end, whereat the bracket comes into blocking engagement with the track on which the winch is mounted, thereby limiting the loading of the spring to about 170 degrees of rotation. The stiffness of the spring is such that with a three foot long tommy bar, this degree of spring torque loading requires a lifting force of about 120 lbs applied to the tommy bar

The lobed end plate also carries a ratchet pawl pivotally suspended from the outer side of the end plate. The loading bracket is mounted on the inner side of the end plate lobe.

The ratchet pawl, which is suspended from the lobe portion of the barrel end plate, can pivot radially inwardly, automatically under its own weight, into ratcheting engagement with the capstan ratchet wheel when the tommy bar is engaged, and the end plate rotated through about 160 degrees.

In use, with the end plate ratchet pawl hanging clear of the ratchet wheel, the capstan can be used in the same fashion as was the original capstan, to take up and tension the load

belt, or to enable the releasing of the winch original ratchet. Such take-up and tensioning of the load strap is obtained by downward movement of the tommy bar.

Relocation of the loading tommy bar into the loading bracket, and with as much as about a half-turn upward rotation of the bar, serves to tension the spring to as much as about 360 pounds-feet, while also causing the ratchet pawl to swing under its own weight into ratcheting engagement with the capstan/ratchet wheel.

This serves to lock-in the applied torque, which is simultaneously applied to the spring, to the capstan/ratchet wheel, and thus, to the winch, being applied to the winch in a direction to sustain the loading of the load strap. Thus, in the event of load movement that leads to a reduction in tension in the load strap, the spring load will come into play, to maintain the strap load and immediately counter the tendency of the strap to slacken.

When the spring is initially loaded, the total load applied by the winch to the load strap may then be significantly increased from its usual manual-loading limit of about 600 pound-feet to upward of 1000 pounds-feet, utilizing the available torque provided by the spring as a booster, to enhance a further downward loading applied by the tommy bar to either the capstan, or the barrel, in the normal manual-loading fashion.

Used in this fashion, the load applied to the load restraining strap is "pumped" up to a significantly higher value, in the order of about 160% of that usually achievable by unassisted manual loading.

In use, with the spring-loaded tensioning means resiliently loaded and coupled by way of the ratchet wheel and pawl to the winch drum, upon diminishment of the load-securing tension in the load strap to a value less than the available spring force, the spring-loaded tensioning means operates to rotate the winch drum, to maintain the load strap in a

tensioned condition.

Thus, in the subject improved load restraint system the spring-loaded tensioning means includes coupling means that are attached in torque-transfer relation with the drum of an existing winch to enable the connection of the spring-loaded tensioning means with the rotatable drum, in torque transferring relation therewith.

In the present invention, for an OEM spring-loaded winch or for a reworked winch, where the original winch drum is journaled in the end frame member of the winch adjacent its capstan, the bore in the frame end plate is enlarged sufficiently to accept entry therethrough of the spring barrel, thus reinforcing the winch drum against the increased bending moment loads that arise as a consequence of the increased overhang associated with the outboard attachment of the spring system.

An annular shoulder or "stop-washer" secured about the winch drum serves to limit the penetration of the spring barrel into the drum space.

The winch ratchet and pawl arrangement also is strengthened to meet the greater loads that can now be applied by the winch, which loads are of course also applied to the structure of the winch. Thus, a ratchet pawl spring is provided, to maintain the ratchet in engaged relation with the ratchet wheel.

Also provided is a ratchet clip which is removably mounted on the winch end frame and can be relocated in locking relation with the ratchet pawl to hold the ratchet pawl in either a downward, engaged position, or in an upward, disengaged position.

A further provision is a dual ratchet wheel having a pair of 6-tooth ratchet wheels in place of the usual 12-tooth ratchet wheel, the teeth of the twin wheels being in mutually off-set relation, so as to provide the tooth pitch effect of a 12-tooth ratchet wheel, but

with the greater tooth strength that a 6-tooth wheel makes possible.

The subject spring-loaded tensioning means may include low-friction support bearings for the rotational parts.

In the subject embodiment, when installed, the spring free end is secured against rotation by way of attachment to the adjoining capstan frame. A cranked plate having its ends welded to the adjacent outside face of the capstan frame forms a recess to receive the spring end in inserted, withdrawable relation.

In using these embodiments, the automatic ratchet pawl engagement of the added gravity-positioned pawl has the particular advantage that an operator/trucker can retain both hands upon the lever/tommy bar when applying torsion loading to the spring. Stiff springs are used, such that for approximately one half turn of the spring, a torque of up to about 360 pounds-feet is generated. This can impart up to about six to eight inches of tightening displacement to a load strap, while retaining considerable tension upon that strap.

BRIEF DESCRIPTION OF THE DRAWINGS

Certain embodiments of the invention are described by way of illustration, without limitation thereto other than as set forth in the accompanying claims, reference being made to the accompanying drawings, wherein:

Figure 1 is an end perspective view showing a portion of a standard type of truck winch, together with the elements of one embodiment of the present invention in exploded, disassembled relation;

Figure 1A is a side view of the truck winch of Figure 1 in assembled relation;

Figure 2 is a perspective view of a winch ratchet wheel with a spring-loaded pawl;

Figure 2A is a perspective view of the pawl spring of Figure 2

Figure 3 is an end elevation of a subject winch with a dual ratchet wheel and spring-loaded pawls;

Figure 3A is a perspective view of a safety clip embodiment of the present invention;

Figure 4A shows the safety clip of Figure 3A applied in locking relation with the dual pawls of Figure 3;

Figure 4B shows the safety clip of Figure 3A applied in deactivating relation with the pawls of Figure 3.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figure 1, a portion of a winch 10 is shown, having a top frame member 12, a frame end member 14, and a drum 16, with a capstan 18 projecting from the member 14, to which capstan 18 the safety adaptation kit 20 in accordance with the present invention is mounted. The capstan 18 has four bar apertures 19 that normally receive the tapered toe of a trucker's loading bar (not shown), known as a "tommy" bar.

In the case of an OEM or a reworked winch embodiment, the recess in the winch endplate 14, through which the capstan 18 protrudes, is bored out to a predetermined greater diameter, giving a radial clearance from the drum 16/capstan 18, as shown.

The kit 20 has a mounting barrel 22 with a first diametrical aperture 23 that matches a pair of the apertures 19 of the capstan 18. With the mounting barrel 22 positioned on the capstan 18, a cylindrical mounting pin 24 can be inserted through the respective aligned apertures 23, 19, 19, 23 of the barrel 22 and capstan 18, to securely mount the barrel 22 upon the capstan 18.

In the case of the OEM and refitted embodiments, an extended left-hand portion of the

barrel 22 is entered through the enlarged bore in the endplate 14, to provide enhanced resistance to the increase in bending moments applied by the overhung safety kit 20. The barrel 22 has a second diametrical aperture 25 at its outer end.

A pin retaining cylinder 26 is then slid over the barrel 22, to trap the mounting pin 24 in secured relation in the capstan 18 and barrel 22.

A torsion spring 30 is then slid over the barrel 22, and a protruding inboard end 32 of the spring 30 is secured to the winch end frame member 14 by way of a bracket 34, which is welded to the frame end member 14.

A rotator cuff 36 (see also Figure 2), is inserted over the barrel 22, being entered in supporting relation within the outer coil of spring 30, with an outer tang end portion 31 of the spring 30 being inserted axially into a bushing 38 that forms a part of the rotator cuff 36. The cuff 36 has a diametrical access aperture 37, through which a spring pin 44 can be passed for securing in locked relation the aligned apertures of other component parts.

A capstan 40 with an integral ratchet wheel 42 is inserted into the outer end of the barrel 22, having a diametrical inner aperture 43 of capstan 40 aligned with aperture 25 of the barrel 22, and with a diametrical access aperture 37 of the rotator cuff 36.

The spring pin 44 is inserted through and past the aligned diametrical access aperture 37 of the cuff 36, into engaging relation with the apertures 25, and 43 of the barrel 22 and capstan 40 respectively, which serves to secure the barrel 22 and capstan 40 in mutual rotational and torque transfer relation, independently of rotator cuff 36.

The spring pin 44 has a length that is less than the inner diameter of the cuff 36, being located so as not to make contact with the cuff 36 or impede the free rotation of cuff 36 upon the barrel 22.

Referring to Figure 1A, this shows the subject elements of Figure 1 in assembled relation, ready for use in securing a pull-down load on trucks, flat beds and the like.

The inward axial displacement of the barrel 22 along the drum 16 is limited by an annular shoulder or "stop-washer" 19 secured about the winch drum.

The drum 16 is manually driven by capstan assembly 14, by means of a lever or tommy-bar in the usual pull-down fashion.

Such tommy bars are usually about 3-feet long, enabling a 200-pound trucker to pull down a torque of about 600 lbs-feet on to the winch. A ratchet wheel and pawl assembly 11, illustrated as being located at the left-hand side of the winch10, prevent overhauling of the winch 10 by the load strap (not shown) that is threaded through the drum slot 17, and wrapped about the drum 16.

Downward motion of the tommy bar when located in the capstan 47 serves to wind excess load strap onto the drum 16, and to tension the load strap.

The ratchet pawl 52 is suspended from the barrel end plate 44 such that it can pivot under its own weight when in the raised (12-oclock) position into ratcheting engagement with the capstan ratchet wheel 58.

In use, with the spring 30 untensioned, and the end plate ratchet pawl 52 hanging clear of the ratchet wheel 42, the capstan 47 can be used in the same fashion as was the original capstan 18, to rotate the winch drum 14 and take up and tension the load belt, which is secured by the winch original ratchet 11, shown in Figure 1A.

Wind-on and tensioning of the load strap is provided by downward movement of the tommy bar.

Relocation of the tommy bar 20 into the barrel capstan hole 50, with an upward half-turn

rotation of the bar, serves to tension the spring 30 to as much as about 400 lbs feet, while causing the ratchet pawl 52 to swing under gravity into ratcheting engagement with the capstan/ratchet wheel 58.

This serves to lock the torqued spring 30 to the capstan/ratchet wheel, and thus, to the winch drum 16, with the spring tension acting in the direction to sustain the load applied to the load strap.

To release the load applied to the hold-down member, the load on the capstan 47 is increased sufficiently to permit retraction of the pawl 52 from engagement with the ratchet wheel 58.

The spring tension can then be released under control of the tommy bar, moving downwardly.

The winch drum ratchet 11 can then be released, in usual fashion.

In operation, in the event that the load settles, such as to normally cause slackening of the load strap or other load hold-down member, the torque applied by the spring 30 will cause the winch to rotate and maintain tension in the load strap, so that slack is unlikely to occur, and the slackening effect upon the load strap of load settlement is at least partially compensated for.

In a typical instance, the spring can take up of as much as several inches of the hold-down strap, while maintaining the strap under tension.

The available spring tension, as applied to the load strap, diminishes progressively, as take-up occurs.

Overhauling of the system is prevented by the operation of the winch ratchet 11, which contains excessive loads that may be applied to the hold-down strap, due to motion of the

vehicle.

Turning to Figure 2, the ratchet 11' has a ratchet spring 60 in downward pressing relation on the ratchet pawl 13, to maintain the ratchet in positive engaged relation despite load surges that can unload the ratchet, and upward forces acting on the pawl as a consequence of vehicular motion which otherwise could disengage the ratchet.

Turning to Figure 2A, the pawl spring 60 has a coil 62, with an extended side arm portion 64 to engage the pawl 13, and a short, axially extending anchor portion 66, the end of which can be seen in Figure 2.

Turning to Figure 3, a composite, twin ratchet wheel 70 is shown, the ratchet teeth of the two wheels being mutually offset by 30 degrees, so as to collectively provide a ratcheting interval of thirty degrees, equivalent to a 12-tooth ratchet wheel, but possessing significantly enhanced tooth strength.

Referring to Figure 3A, a safety ratchet clip 80 of spring steel has a U-shaped clip portion 82,with an out-turned toe portion 83, to facilitate applying the clip 80 to the winch endplate 14, as shown in Figures 4A and 4B. The clip 80 has an axially projecting side-bar portion 84, to engage the ratchet pawls 13', holding them downwardly in a locked, engaged condition (Figure 4A), or upwardly in a locked, disengaged condition (Figure 4B).